

A Comparative Study of the Surgical Procedures to Treat Advanced Kienböck's Disease

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We have treated a total of 16 cases of advanced Kienböck's disease, stage III and IV by Lichtman's classification, with trisaphe fusion, tendon ball replacement arthroplasty after excision of lunate, proximal row carpectomy as a salvage procedure and limited wrist fusion, since 1985. All cases were followed for minimal 16 months after each operation. Tendon ball replacement arthroplasty after excision of lunate could not prevent further carpal collapse with persistent chronic wrist pain. The trisaphe fusion or radio-lunate fusion induced a marked limited wrist motion later, and the trisaphe fusion alone was not fit for the treatment of advanced one because of progressive proximal migration of capitate and continuous wrist pain due to ligamentous carpal instability in follow-up. So we tried to simultaneously combine tendon ball replacement arthroplasty after excision of lunate with trisaphe fusion in far advanced Kienböck's disease, and their end results was favorable. Proximal row carpectomy could be done in far advanced Kienböck's disease with reasonably painless wrist motions. The overall end results of proximal row carpectomy are much better than any form of carpal arthrodesis. Conclusively the proper way to treat advanced Kienböck's disease seems to depend on the patient's age, their job and sex, and the stage of disease. And the cause of wrist pain in advanced Kienböck's disease seems due to ligamentous carpal instability rather than osteoarthritis on radio-lunate joint.

Key Words: Advanced Kienböck's disease, Trisaphe fusion, Replacement arthroplasty, Radio-lunate fusion, Proximal row carpectomy

INTRODUCTION

With the progression of Kienböck's disease, avascular necrosis of the lunate, symptoms of synovi-

tis predominate, and in late stage arthritis on radiocarpal joint associated with carpal collapse are the predominant pathologic condition and painful limited wrist motions are final clinical outcome(Kienböck, 1910).

Advanced Kienböck's disease may be treated by silicone replacement arthroplasty(SRA), tendon ball replacement arthroplasty after excision of lunate, limited intercarpal or trisaphe fusion and salvage proximal row carpectomy and so on(Alexander and Lichtman, 1988).

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We had no experience with SRA, but SRA is widely not indicated in far advanced Kienböck's disease (stage III & IV) with carpal collapse, and silicone induced synovitis would also be a serious complication (Swanson, 1970; Lichtman *et al.*, 1982).

Good results with tendon ball replacement arthroplasty after excision of lunate have been reported (Ishiguro, 1984), but bad results because of proximal capitate migration and carpal instability later are also noted (Rhee and Hur, 1988). Following limited intercarpal fusion between lunate and adjacent carpal bones, there may be moderate to marked limited wrist motion (Graner *et al.*, 1966). In triscaphe fusion, overcorrection of the scaphoid rotation can result in scapho-radial joint, and furthermore, SRA may be required as a second procedure later (Watson *et al.*, 1985).

Despite the recommendation by Cotton in 1924 and subsequently by others (Campbell *et al.*, 1965; Jorgensen, 1969) that the proximal row of carpal bones could be removed in the presence of some disease in the proximal carpal row of wrist joint, various wrist stabilizing procedures, such as, arthrodesis or SRA are usually recommended.

So, the method of treatment for advanced Kienböck's disease are not established yet and there are so many controversies. Through this study, we have analyzed their long-term end results of various common treatments of advanced Kienböck's disease, and tried to find the best way for its treatment.

MATERIALS AND METHODS

Since 1985, a total of 16 cases of advanced Kienböck's disease (Lichtman stage III & IV) were treated with triscaphe fusion (scapho-trapezio-trape-

zoideal, STT fusion, 7 cases), fascia lata anchoring tendon ball replacement arthroplasty after excision of lunate (4 cases), proximal row carpectomy (3 cases) and limited intercarpal fusion (2 cases), and followed them for minimal of 16 months after each operation.

According to the Lichtman's classification, stage IIIA in 9 cases, stage IIIB in 5 cases and stage IV in 2 cases were defined radiologically.

Their end results were analyzed with clinically (subjective pain, objective wrist motions and grip strength) and radiologically (serial motion studies for flexion, extension, ulnar and radial deviated X-rays), and compared with opposite normal wrist in all cases. The grip strength measured by Preston's dynamometer was compared with normal persons.

RESULTS

Ages were ranged from 21 to 47, average 29. Male (12/16) and right wrist (14/16) are frequently involved. Most of patients were not related with trauma history previously (11/16) and also with ulnar negative variance (5/12). Chronicity of wrist symptoms for more than 4 months with tenderness over the dorso-radial aspect of wrist and limited wrist motion, especially on dorsiflexion were noted.

Fascia lata anchoring or tendon ball arthroplasty after excision of lunate seemed to be favorable in early results. But carpal collapse with ligamentous instability, proximal migration of capitate and rotational deformities of scaphoid progressed in long term follow-up serial x-rays. Wrist pain increased, wrist motions (average 35° of flexion and 30° of extension) were markedly decreased and grip strength was also decreased (average 62 % of a normal person's wrist) in last follow-up.

Table 1. Treatment and results of advanced Kienböck's disease

Treatment	Cases	End Results		
		Pain	Wrist motions	Grip strength*
Triscaphe (STT) fusion	7	mild	Flexion 0-35° Extension 0-45°	91 %
Limited carpal fusion	2	mild	Flexion 0-30° Extension 0-20°	95 %
Replacement arthroplasty after lunate excision	4	moderate	Flexion 0-35° Extension 0-30°	62 %
Proximal row carpectomy	3	mild	Flexion 0-50° Extension 0-40°	70 %

* : Grip strength was compared with normal person's.

In long term follow-up of STT fusion, wrist pain was not completely relieved, the lunate collapsed a bit radiologically and the wrist motions were restricted (average 35° of flexion and 45° of extension). Flexion was limited more seriously than extension. Grip strength was not changed (91 % of a normal person's).

Limited wrist fusion with either radio-lunate or radio-scapho-lunate had markedly limited wrist motions (average 30° of flexion and 20° of extension of

wrist), but wrist pain was mild at work and grip strength was nearly same as a normal person's.

The end result of proximal row carpectomy was regarded as good with reasonable painless wrist motions (average 50° of flexion and 40° of extension), and their grip strength was not decreased as much as we thought before operation (average 70 % of normal person) (Table 1).

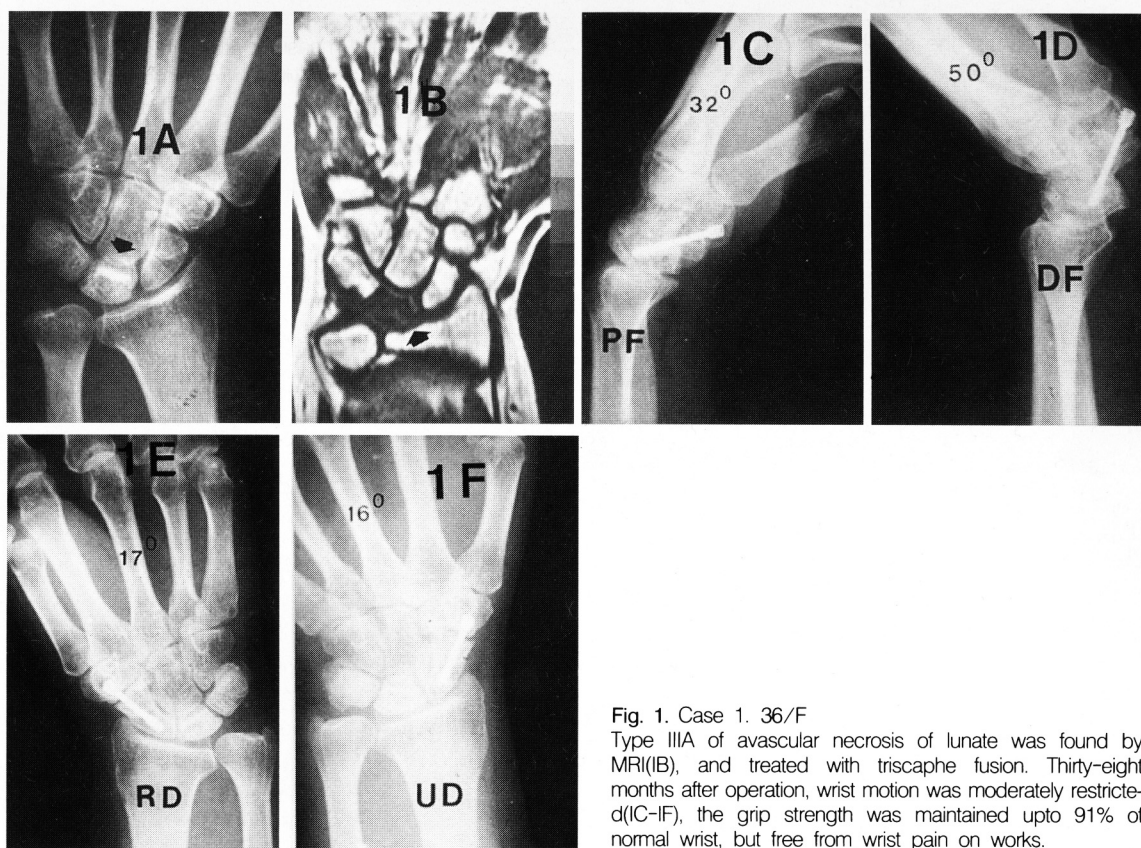


Fig. 1. Case 1. 36/F
Type IIIA of avascular necrosis of lunate was found by MRI(1B), and treated with triscaphe fusion. Thirty-eight months after operation, wrist motion was moderately restricted(1C-1F), the grip strength was maintained upto 91% of normal wrist, but free from wrist pain on works.

Case Reports

Case 1

A 36 year old housewife complained of painful limited motion on left wrist for 18 months without any remarkable trauma history. Plain radiograph revealed some sclerotic changes of lunate without collapse(1A)

but T1 weighted MR imaging revealed a total avascular change of lunate which was diagnosed by Lichtman stage IIIA(1B). She was treated with triscaphe fusion using a Herbert screw. 38 months later post-operatively, a dynamic radiograph showed limited motions of wrist when compared to nonoperated wrist, with palmar flexion 56°/32°, dorsiflexion 65°/50°, radial deviation 23°/17° and ulnar deviation 29°/16° in each

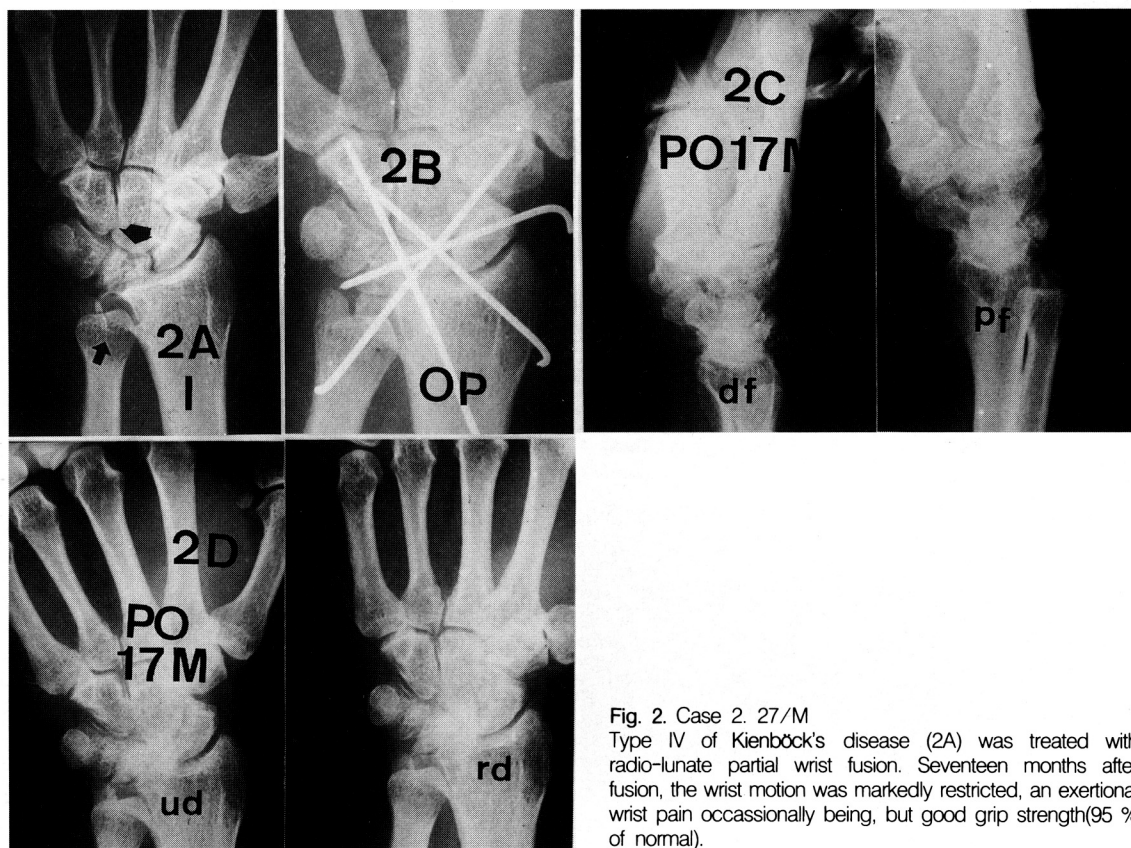


Fig. 2. Case 2. 27/M

Type IV of Kienbock's disease (2A) was treated with radio-lunate partial wrist fusion. Seventeen months after fusion, the wrist motion was markedly restricted, an exertional wrist pain occasionally being, but good grip strength(95 % of normal).

direction(1C-1F), respectively(Fig. 1A-1F).

The grip strength averaged 91 % of a normal person's but free from pain.

Case 2

A 27 year old heavy laborer from a steel company complained of painful limited motion on right wrist for 6 months. He presented with Lichtman stage IV aseptic necrosis of lunate(2A) with multiple fragmentation and also cystic degenerative changes on articular surface of distal radius(↑). He was so treated with limited intercarpal fusion between radius and lunate(2B). Seventeen months later postoperatively, marked limited motion of wrist joint developed, which composed of ulnar deviation 12°, radial deviation 20°, palmar flexion 12° and dorsiflexion 19° respectively(2C & 2D). The grip strength averaged 95 % of a normal person's but with an exertional pain occasionally(Fig. 2A-2D).

Case 3

A 44 year old housewife complained of pain on anatomical snuff box of left wrist for 16 months. She had no definite trauma history. She presented with Lichtman stage IV aseptic necrosis of lunate associated with advanced osteoarthritis on the radiocarpal joint(3A). She was treated with excision of lunate, followed by interposition of tensor fascia lata flap(Anchovy operation). Postoperative radiograph(3B) showed widening of carpal height, but 2 months later, postoperatively, some structural alteration developed, which composed of rotational and foreshortening of scaphoid with ulnar translation of carpus(3C). Eleven years later postoperatively, no more carpal collapse including distal migration of capitate or ulnar translation of carpus developed(3D). The postoperative result rated good despite occasional pain during exertion (Fig. 3A-3D).

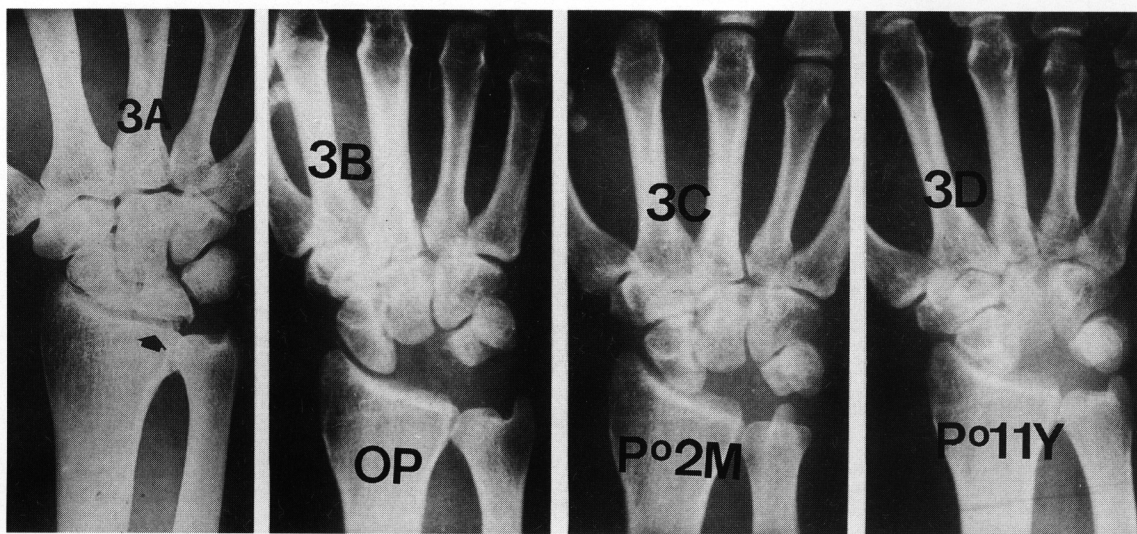


Fig. 3. Case 3. 44/F

Type IV of avascular necrosis of lunate (3A) was treated with lunate excision followed by interposition of tensor fascia lata flap (3B). Follow-up after 11 years shows progressed carpal collapse, moderately reduced wrist motions and grip strength (70 % of normal) but painfree.

Case 4

A 27 year old carpenter complained of painful limited motion on his left wrist for 9 months. He had daily repeated heavy work but no remarkable trauma history. He presented with Lichtman stage IIIB aseptic necrosis of the lunate, which was associated with early stage of osteoarthritis on the radiocarpal joint (4A). He was treated with proximal row carpectomy (4B) and achieved a painfree, though somewhat reduced range of wrist motions (dorsiflexion 40°/palmar flexion 50°) on 26 months later (4C & 4D). Grip strength averaged 70 % of a normal person's and he returned to heavy carpenter work again despite some misgivings (Fig. 4A-4D).

DISCUSSION

Many cases with no trauma history previously in Kienböck's disease have been proved throughout this study (11/16, 68.8 %) and this finding corresponds to Blaine's report (1981). Accordingly, the main cause of Kienböck's disease is considered to be improper anatomical environments in and out of the lunate including wrist joint rather than trauma. According to Gelberman and Saxbo in 1984, a peculiar blood supply of lunate has been reported. More than 90 %

of lunate has a circulatory system by the arteries of volar and dorsal system both, 7 % of population has only the volar arterial system and particularly, the lunate has also simple intraosseous circulation such as that of Y, I or X type. But we don't know yet clearly that various minor trauma around the wrist will cause the damage of lunate.

As for the abnormalities that have been proved among the abnormal anatomical environments out of the lunate in Kienböck's disease, Hulten (1928, 1935) reported ulnar negative variance occupied 23 % of normal people while it occupied 18 cases out of 23 Kienböck's disease (78.3 %). Gelberman (1975) also agreed with Hulten's idea that negative variance was so significant that 29.2 % of 476 white people and 21 % of 419 black people, but 13 cases (80.7 %) out of 15 Kienböck's disease had negative variance. On the contrary, Chan and Huang (1971) insist that 17 % out of 400 normal Chinese had negative variance while there is no report on Kienböck's disease with negative variance in China yet. And Park & Sohn (1982) in Korea also reported no correlation between ulnar negative variance and Kienböck's disease because 2 cases out of 10 Kienböck's disease only had negative variance but 59 (20 %) out of 296 normal adult Korean had negative variance. However, since 5 cases out of a total 16 cases (31.3 %) indicated

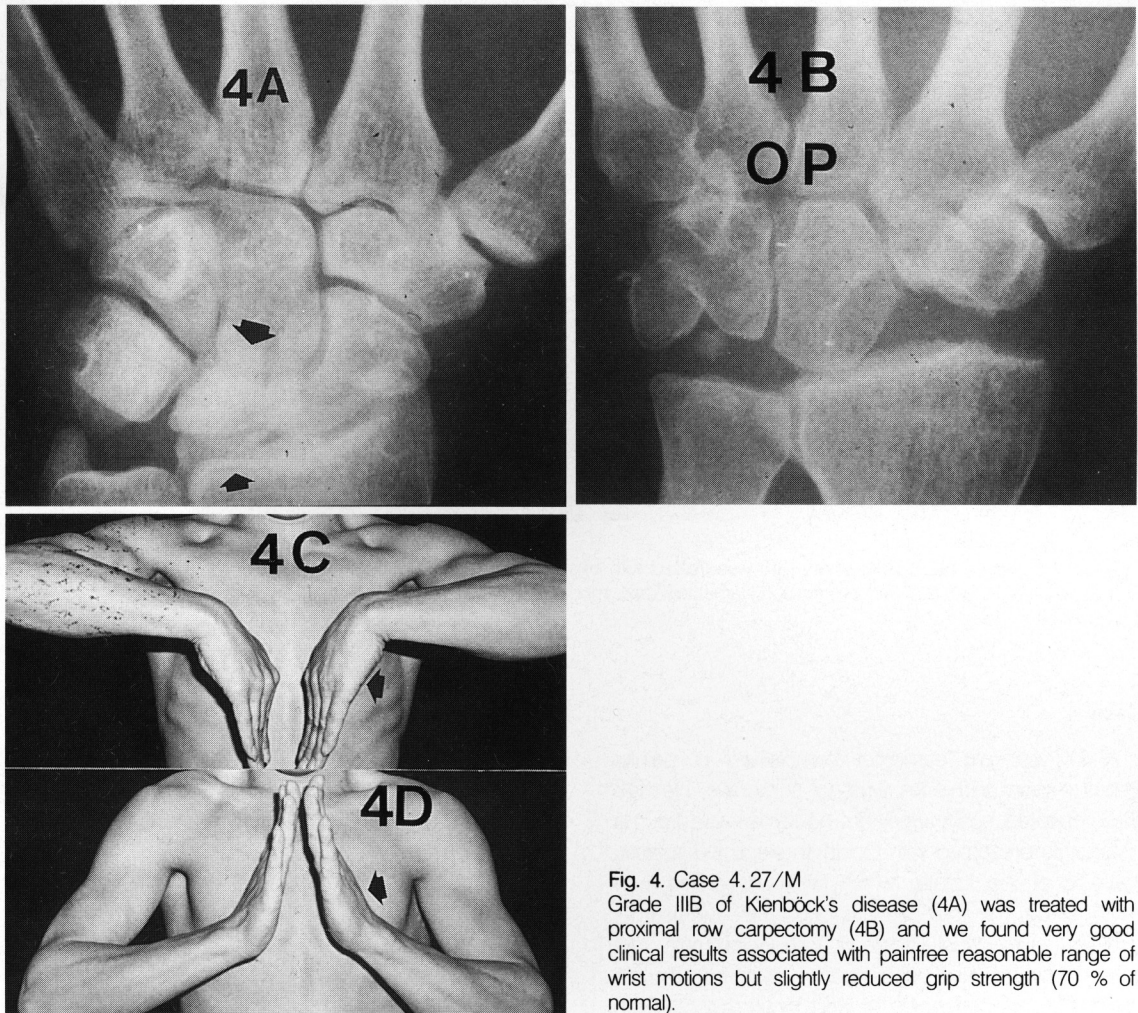


Fig. 4. Case 4. 27/M
Grade IIIB of Kienbock's disease (4A) was treated with proximal row carpectomy (4B) and we found very good clinical results associated with painfree reasonable range of wrist motions but slightly reduced grip strength (70 % of normal).

negative variance in this study, this made us believe that there are no close relations with the cause of Kienbock's disease.

Palmer & Werner(1984) found out that 81.6 % of axial loads to wrist press the radius, and the rest 18.4 % influenced the ulnar head. Especially, in case with 2.5 mm negative ulnar variance, 95.7 % of axial loads to radius while only 4.3 % to ulnar head will be compressed. Such a report evidences that there is a significant relationship between negative ulnar variance and the pathophysiology of Kienbock's disease, and it is also considered to be more effective regarding that radial shortening rather than ulnar lengthening distributes loads more evenly to the

affected wrist. By the way, favorable results of radial shortening in early stages of Kienbock's disease are reported by others(Hulten 1935, Lichtman et al 1977).

Concerning the treatment of advanced Kienbock's disease so far, Nahigian and Li(1970), Schmitt et al(1984) and Ishiguro(1984) reported that they had good clinical results by packing the roll of flexor tendons or fascia lata flap after removal of avascular lunate. In particular, Ishiguro(1984) established this technique by animal experiment and reported that the replacement tendon into the wrist was finally collagenized and hyalinized histologically, act as a good spacer, and 17 cases out of 26 cases showed good results clinically. We had also once reported(1988) 4

cases of long term results with this technique, but some progressive carpal collapse and rotational scaphoid deformity were inevitable in long-term follow-up. And the grip strength was also markedly decreased. Accordingly, to improve this technique, we once asserted since 1991 that the packing of roll of fascia lata or flexor tendon flap as well as triscaphe fusion after removal of lunate should be simultaneously done to prevent further carpal collapse after operation, and, comparatively good clinical and radiological results could be obtained.

Watson et al.(1985) reported that the wrist pain in Kienböck's disease would be caused by the decrease of contact surface between distal radius and proximal carpal bones due to rotational translation of scaphoid ulnarly and by stretching the intercarpal ligaments due to distal migration of capitate rather than the necrosis of lunate. And they attempted to restrict the motion of scaphoid by triscaphe fusion to prevent the collapse of carpal height ratio, and reported good clinical results in Kienböck's disease treated with triscaphe fusion. Kang et al(1988) also reported a good clinical and radiological result with triscaphe fusion in Korean Kienböck's disease. But we found in long term follow-up, wrist pain was not relieved for long time, the range of wrist motion was also moderately restricted and the lunate collapsed more later. So this operation alone in advanced Kienböck's disease could not obtain good end results if the joint space between STT fusion does not fully maintained by autogenous bone graft. Limited wrist fusion also induced markedly limited wrist motions, worst end result in our studies, but the pain was mild and the grip strength was not changed.

Classically, wrist or intercarpal arthrodesis is advocated in advanced Kienböck's disease only after other conservative measures have failed. Although a radiocarpal fusion, when successful, leads to a painless stable wrist, the loss of normal wrist motions inevitably results in some loss of hand function. But the proximal row carpectomy, removal of the lunate, triquetrum and scaphoid, is suggested when motion as well as stability of wrist is needed. It was a comparatively simple, uncomplicated surgical procedure. We found in this study that the proximal row carpectomy could be done in far advanced Kienböck's disease with arthritic change on the radiolunate region as a salvage procedure, and their end results was good with painless wrist motion but moderately weakened grip strength, 70 % of a normal person's.

Conclusively, all the ways of treatment for advanced Kienböck's disease had their own advantages and disadvantages, and so there is no single way to treat them. The best way to treat advanced Kienböck's disease should be decided according to the patient's age, sex, their job, and the radiologic stage of disease.

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